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UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF ENTOMOLOGY  
FOREST INSECT INVESTIGATIONS

A PRELIMINARY INVESTIGATION OF THE  
ENGELMANN-SPRUCE BEETLE

By  
F. B. Foley  
Field Aide

Forest Insect Field Station  
Coeur d'Alene, Idaho  
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#### PREFACE

It is felt that the following report should be prefaced by a few words in order that the reader will have a full understanding of why the work was undertaken. At the time of this study, Mr. Foley was assisting in an investigation of the mountain-pine and Douglas-fir beetles under the direct supervision of Mr. Bedard. Mr. Foley felt that he would like to carry on a study of his own in whatever spare time there was available, and consequently decided to investigate more closely the biology and habits of the Engelmenn-spruce beetle. This beetle is reported to have been very destructive and if control work were ever instituted, detailed information concerning the seasonal history would be indispensable.

But little is known regarding this insect, and all present knowledge is based upon field observations with no substantiatory detailed investigation. Dr. Hopkins has described the type of gallery as well as given a brief note as to its seasonal history. Also, the fact that insect-killed spruce trees drop their needles green has been observed at this station for many years. Other than this, the work in the following report is new, and where not new, it substantiates our present knowledge.

Mr. Foley has done a commendable piece of work, utilizing Sundays and evenings in which to make his study, and it is felt that his data should be made available to other workers.

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J. C. Evenden,  
Entomologist.

## INTRODUCTION

During the 1932 field season, a preliminary study of the biology and habits of the Engelmann-spruce beetle (Dendroctonus engelmanni Hopk.) was made in the spare time available to the writer during evenings and Sundays. The work was done in the region of Metolene Falls, Wash., on the Koniksu National Forest, where the beetle was found working in Engelmann spruce. The host tree was found in limited numbers, occurring only in canyon bottoms and along streams, the beetles being only sufficiently aggressive to attack weakened trees and windfalls. Although the study was conducted in a normal infestation, it is hoped the findings will add to the knowledge of the beetle in forests where it is of economic importance.

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#### THE ENGELMANN-SPRUCE BEETLE

"The Engelmann-spruce beetle is a reddish-brown to black bark-beetle, 5 to 7 mm. in length, with body sparsely clothed with long hairs, head broad and convex, prothorax sometimes darker than the elytra and with sides of pronotum distinctly narrowed and constricted toward the head and the punctures of irregular size and distinctly coarse, the elytra with coarse rugosities between rows of indistinct but coarse punctures and the declivity convex and somewhat flattened. It attacks Engelmann spruce, and probably other spruces, from central Idaho southward to the mountains of southern New Mexico, and the white spruce in the Black Hills of South Dakota."

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Hopkins, A. D. 1909. Bark Beetles of the Genus Dendroctonus. U. S. D. A. Bull. 83.

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#### EVIDENCE OF ATTACK

Appearance of Foliage: Due to the endemic condition of the infestation, only one standing infested tree was found, and although this tree had been attacked in June, there appeared to be no change in foliage until late in October. On October 29 the tree was visited after a light snow storm. At that time all of the needles of the lower one third of the crown had fallen, while some in the upper two thirds, especially those near the bases of branches, were turning light in color. The crown presented an unhealthy, fading condition, rather than a "red top". However, two trees which had been girdled by cutting the cambium on July 19 and August 21, respectively, showed no change in foliage by November. A number of Engelmann spruce were found that had been killed in previous years by the mountain-pine beetle. These were "black tops" with no needles.

The results of these observations suggest that successfully attacked Engelmann spruce do not become "red tops", but lose their foliage while green or fading during the winter following the attack.

Pitch Tubes: Very few pitch tubes were found on Engelmann spruce killed by either the Engelmann-spruce beetle, or the mountain-pine beetle. This may have been due to the weakened condition of the host.

Boring Dust: Boring dust was not conspicuous, either on the ground, or on the bark.

#### TYPE OF WORK

All work is done between the bark and wood. The egg gallery is of the simple, longitudinal type, and averages about six inches in length. The entrance burrow is oblique, packed with frass, and but slightly wider than the beetle. The remainder of the gallery is straight and twice as

wide as the beetle, so that frass can be packed along the sides, leaving a narrow tunnel in the center of the gallery, through which the beetles move. Along the roof of this tunnel are found three or four wide and deep turning niches, or ventilation holes, which come so near the outer surface of the bark that many can be partially exposed by breaking off bark scales. At the upper end of the gallery is an irregular cavity which serves as a resting place after egg laying is completed. In cases where a male is present, a short side branch may be made.

Eggs are packed with boring dust in two or three single rows alternately along the sides of the gallery. There are from 10 to 30 eggs in each row. When the eggs hatch, the young larvae in each group work out en-masse for a short distance from the main gallery, forming a cavity which barely scores the wood. Upon reaching the second or third instar, they separate and make individual mines in all directions between the bark and wood. These mines terminate in pupal cells six to eight inches from the main gallery. Pupal cells are, for the most part, in the bark.

#### PERIOD OF ATTACK

The newest attack was found on July 1, and this was estimated to be two weeks old. All infested material found later in the season contained brood of corresponding age, thus establishing an attack period at about the middle of June.

To see if there would be a later attack due to emerging parent adults, infested material was placed in a cage with a green spruce log on July 12. In the field, two green spruce trees near windfalls infested with the Engelmann-spruce beetle were girdled on July 19 and August 21, respectively, to act as possible hosts for emerging parent adults.

On July 18 the caging experiment showed two emergence holes in the

infested material, and two attacks in the green log. No further emergence occurred. Whether the second attacks were successful, and the broods able to overwinter, will be determined by examination of the material the following spring.

The trees that had been girdled in the field were not attacked, and no emergence holes were found in the infested windfalls. Similarly, an examination on October 31 of 24 Engelmann-spruce logs cut as slashings by the Forest Service in August, failed to show any evidence of attack.

If experiment shows that the beetles are able to make a second successful attack, it is possible that this may occur in other localities, or in cases of epidemics. For 1933, in the region of Metaline Falls, Wash., however, it is quite evident that there is but one period of attack with no parent adult emergence from these attacks during the same season.

#### DEVELOPMENT OF BROOD

On July 1, the oldest galleries were two inches long, and contained the first row of eggs. During the next ten-day period most of the eggs hatched, and small larvae were starting to work out en masse. By late July, egg galleries averaged five inches in length, and contained a second row of eggs. In many cases these eggs had hatched, and larvae were working in a manner similar to those of the first group. A few of the oldest larvae were beginning to make individual mines.

By early August, egg laying had been discontinued. The largest larvae, which were now from 5 to 7 mm. in length, were making individual mines four to five inches from the main gallery. By the middle of August, they had made pupal cells, and on August 24 several pupae and one new adult were found. By the middle of October, when development had ceased due to cold weather, the brood consisted of 75 per cent prepupal larvae.

and 25 per cent new adults.

After egg laying had been discontinued, the parent adult beetles extended and widened the galleries irregularly for about an inch, by gouging out the bark and wood, and packing the frass loosely in the passageway in back of them.

At the end of the season all parent adults were alive, no dead beetles having been found at any time. A number of apparently dead parent adults became very active when removed from the logs and warmed indoors. That they over-winter alive to emerge and reattack the following year seems unlikely, for if this were true, some would be found dying in the summer or fall after their second attack.

#### Summary of Brood Examinations

June 15 (approximately) - New attacks.

July 1 - Galleries 2" long. Eggs.

July 10 - Eggs and small larvae.

July 18 - Parent adult emergence and attack in cage.

July 24 - Galleries 5" long. Eggs and small larvae.

Aug. 7 - No eggs. Oldest larvae 5 to 7 mm. in length.

Aug. 14 - Larvae making pupal cells.

Aug. 21 - Larvae and pupae. One new adult found.

Aug. 28 - Galleries six inches long (30 gall. av. 5.9").

Sept. 4 - Mostly larvae, less pupae, few new adults.

Oct. 16 - 75% prepupal larvae, 25% callow adults. Parent adults alive.

Activity ceased, due to cold weather.

#### ADDITIONAL OBSERVATIONS

Extent of Attack: In a standing tree, attacks were found as low as 2½ feet from the ground, while in windfalls they occurred from the base to a height at which the diameter was 5½ inches, and the bark  $\frac{1}{4}$  inch thick.

Proportion of the Sexes: Many attacks contained but a single beetle, which, inasmuch as eggs were being laid in each case, were undoubtedly females. This indicates an unequal ratio of the sexes in newly attacked trees. More study must be made to ascertain the sex ratio of emerging beetles.

Natural Enemies: As compared with the mountain-pine beetle and Douglas-fir beetle in the same locality, the broods of the Engelmanna-spruce beetle were relatively free of parasites and predators. Especially noted was the absence of *Cocloides hibernaculi*. Undoubtedly parasites and predators are present, but the limited time available for this study prevented a study of these insects.